## Part 2 Decision Summary

The Decision Summary provides an overview of the cleanup work to date, the contamination remaining in sediment, the associated risks to human health and the environment, the cleanup alternatives considered, and the U.S. Environmental Protection Agency's (EPA's) Selected Remedy to address these risks. It also explains how the Selected Remedy fulfills statutory and regulatory requirements.

### 1 Site Name, Location, and Brief Description

The Wyckoff/Eagle Harbor Superfund site (EPA ID Number WAD 009248295) is located on the east side of Bainbridge Island in central Puget Sound (Figure 1), at 5350 Creosote Place NE, Bainbridge Island, Washington. The Site includes the former Wyckoff Company wood-treatment facility on the south shore of Eagle Harbor, more than 70 acres of contaminated subtidal and intertidal sediments in the harbor, and the upland and in-water portions of a former shipyard on the harbor's north shore.

Historically, the Wyckoff site has been divided into four operable units (OUs), as follows:

- **OU1: East Harbor Operable Unit –** includes contaminated intertidal and subtidal sediments in the eastern portion of Eagle Harbor associated with wood treatment operations at the former Wyckoff facility.
- **OU2: Soils Operable Unit –** incudes contaminated surface soil and structures associated with the Former Process Area (FPA) of the Wyckoff facility.
- **OU3: West Harbor Operable Unit –** includes the upland areas, and intertidal and subtidal contaminated sediments associated with former shipyard operations on the north shore of Eagle Harbor.
- **OU4: Groundwater Operable Unit –** includes contaminated subsurface soil and groundwater associated with operations at the FPA of the Wyckoff Facility.
- OU2 and OU4 are referred to collectively as **OU2/4**, or the **Soils and Groundwater Operable Units**. In this document, this portion of the site is also called the "former process area (FPA)."

EPA is the lead agency for the site, supported by the Washington Department of Ecology (Ecology). EPA added the site to the National Priorities List (NPL) in 1987. Extensive investigation and cleanup activities have taken place in the intervening 30 years. This interim Record of Decision Amendment (RODA) revises two existing cleanup decisions: the East Harbor Operable Unit Record of Decision, signed September 29, 1994, and the Soil and Groundwater Operable Units Record of Decision, signed February 14, 2000.

The current remedy for intertidal beaches in OU1 - monitored natural recovery - failed to meet the ROD's cleanup goals in portions of the beaches adjacent to the former wood treating facility. Sediments in specific areas remain contaminated above risk-based cleanup levels more than 16 years after source control actions were implemented.

**Commented [PHS(1]:** In 2002 Phase III capping work was done. Are we considering that capping work as a source control or installation of sheet-pile wall, or both RA?

The current remedy in OU2/4 - containment - has prevented large-scale releases of contaminants to Eagle Harbor. The containment system includes two components: a steel sheet pile wall around the perimeter of the site and a groundwater extraction and treatment system. The steel sheet pile wall is rapidly corroding and is expected to lose structural integrity within three to five years. The wall needs to be replaced soon. It does not make sense to implement additional cleanup actions in the beaches before the wall is replaced because a failure of the wall could cause catastrophic re-contamination of the

beaches. Therefore, EPA is addressing both issues - ongoing contamination in the beaches and replacement of the perimeter wall - in the current decision document.

Additional cleanup actions are also being planned to address contamination remaining in upland soil and groundwater. The cleanup decision for upland soils and groundwater will be presented in a future decision document.

## 2 Site History and Enforcement Actions

This section of the RODA provides a summary of the Site history and a brief discussion of EPA and State removal, remedial and enforcement activities.

### 2.1 History of Site Operations

Eagle Harbor was used as a Suquamish Tribe village and burial site prior to European contact and development in the latter half of the nineteenth century. Starting in 1903, a major shipyard was established on the north shore of Eagle Harbor. After flourishing during World War I, the yard languished during the 1930s. In the 1940s and 50's, the emphasis was on construction and repair of military ships, and postwar decommissioning.

Wood treating operations began on the harbor's south shore in 1905. From 1905 through 1988, a succession of companies treated wood for use as railroad ties, utility poles, pier pilings, and wood stave pipes. By 1910, pressure treatment with creosote or bunker oil had begun. In later years, wood was also treated with pentachlorophenol (PCP). Early operations took place on docks and pile supported buildings. Over time, a series of bulkheads were built and the area behind them filled, creating the existing upland area. For decades, logs were treated using heat and pressure inside retorts, which are long, cylindrical tanks sealed at both ends. Freshly treated wood was removed from the retorts and dried in the open air. Excess chemical solution that dripped from the wood went directly onto the ground and seeped into the soil and groundwater. This practice began in the mid-1940s and continued until operations ceased in 1988. Other significant contaminant releases resulted from leaking storage tanks and piping, storing treated wood in the water, and using process wastes and sludge as fill between bulkheads in the 1950s.

### 2.2 Previous Investigations and Cleanup Actions in OU2/4, Upland Soil and Groundwater

In 1984, EPA issued a Unilateral Administrative Order requiring the Wyckoff Company to conduct environmental investigation activities under the Resource Conservation and Recovery Act (RCRA). Data collected at the time revealed the presence of significant soil and groundwater contamination. The site was added to the NPL in 1987 and a more thorough Remedial Investigation was completed in 1989.

Groundwater extraction and treatment began at selected wells in 1990. In 1993, EPA assumed responsibility for operation and maintenance (O&M) of the groundwater extraction and treatment system because the company was financially unable to do so. Between 1992 and 1994, EPA conducted a time-critical removal action at the facility, removing creosote sludge and contaminated soils, disposing asbestos, constructing a new bulkhead, and removing and recycling materials left in the retorts and tanks.

In 1994, a Focused Remedial Investigation/Feasibility Study (RI/FS) for the Groundwater OU was completed and an interim ROD was issued. The interim ROD required additional actions, including replacement of the existing groundwater treatment plant and sealing and abandonment of onsite water

supply wells. In 1996 and 1997, most of the remaining above grade structures were demolished and the debris was removed and disposed off-site.

In 1998, EPA conducted an evaluation of thermal treatment technologies, including the removal of contaminants from soil and groundwater using steam injection and groundwater extraction. Steam enhanced extraction was selected in a 2000 ROD for OU2/4. The 2000 ROD also included a contingency remedy – containment – to be implemented if a pilot scale study of steam enhanced extraction could not meet cleanup goals.

In 2001, a steel sheet pile wall was constructed around the perimeter of the site. A smaller sheet pile wall was also constructed around an area of heavily contaminated soils near the center of the site that had been selected for the pilot study. The pilot study began in October 2002. Equipment problems hampered operations, and the pilot study was terminated in April 2003. The most serious problems encountered were aspiration of liquid by the vapor-vacuum pumps, overloading of the water treatment system, and clogging of pipes and treatment facilities by precipitating naphthalene.

EPA determined that cleanup goals for the Groundwater OU could not be met using steam enhanced extraction. EPA began to implement the contingency remedy – containment – in 2004. The aging groundwater treatment system was replaced in 2010. The containment remedy is still in operation today, and consists of the following components:

- **Groundwater Extraction and Treatment System** – The groundwater extraction system consists of nine recovery wells screened in the upper aquifer. These wells draw groundwater and NAPL away from the site perimeter and toward the extraction wells. Ecology has been operating~~es~~ the groundwater extraction and treatment system since 2012.
- **Perimeter Wall** – The interlocking steel sheet pile wall was constructed around the upland portion of the site to prevent the release of contaminants to Eagle Harbor. The wall is more than 1800 feet long. It extends from above the ground downward into a confining layer 25 to 80 feet below ground surface.
- **Long-Term Monitoring** – A monitoring program provides data on water levels in both the upper and lower aquifers beneath the FPA (for confirming hydraulic containment), and on contaminant distribution and movement in the subsurface. Monitoring is ongoing.
- **Engineering Controls** – Engineering controls (e.g., fencing) and access controls have been implemented to restrict site use, thereby preventing direct exposure to surface soils.

### 2.3 Previous Investigations and Cleanup Actions in OU1, East Harbor

The 1989 Remedial Investigation (RI) revealed extensive PAH contamination of surface and shallow subsurface sediments in Eagle Harbor. To address this risk, EPA implemented a time-critical removal action to cap more than 54 acres of contaminated sediments. Capping began in September 1993 and was completed in March 1994. The cap covered contaminated sediments under a thick layer of clean sand. Capping was selected as the primary remedy for sediment contamination in the 1994 ROD for OU1, with Monitored Natural Recovery (MNR) in the intertidal beaches. The cap was extended in several phases and now covers more than 70 acres, as shown in Figure 2.

In 2001, EPA installed the perimeter pile wall (described above) around the west, north, and east sides of the FPA. The wall stopped the discharge of contaminated soil, groundwater, and oily waste to the beaches, allowing the process of natural recovery to begin.

In 2005, EPA received reports from citizens about odors and sheen on the beach west of the FPA. EPA investigated, determined the extent of residual creosote contamination, and designed a three-layer cap called an exposure barrier system (EBS) to cover the contaminated portion of the west beach. EPA documented this additional cleanup decision, which amended the 1994 ROD, in a 2007 Explanation of Significant Differences (ESD). The EBS was built in 2008.

In 2012, EPA determined that cleanup levels had not been met in the intertidal beaches adjacent to the upland portion of the site, despite more than 10 years of MNR following source control measures. After making this determination, EPA began a remedial investigation (RI)~~FFS~~ to evaluate the extent of contamination remaining on the beaches. EPA found NAPL seeps in two areas – East Beach and North Shoal. Creosote is visible when the beaches are exposed at low tide, and it generates sheens and odor on the beach surface. Portions of the beaches remain contaminated with polycyclic aromatic hydrocarbons (PAHs) at concentrations above ~~minimum~~ cleanup levels. In the FFS, EPA also evaluated a range of cleanup options to address the remaining contamination.

In 2017, the EPA repaired a portion of the original cap in Eagle Harbor. State ferry operations had caused erosion of the cap in the vessel traffic lane near the ferry terminal, exposing contaminated sediment. The repair included placing new sand over 9 acres of the cap, and armoring 4 acres of the repair area with a rock layer to prevent future erosion.

### 2.4 Previous Investigations and Cleanup Actions in OU3, West Harbor

The EPA's 1989 Remedial Investigation (RI) of Eagle Harbor included intertidal and subtidal sediments across a large portion of the harbor. The RI revealed an area of metal-contaminated sediment offshore of the former shipyard on the north side of the harbor. EPA issued an initial cleanup decision for the shipyard, the West Harbor Record of Decision (ROD), in September 1992, then amended the cleanup decision in December 1995. The remedy included upland source control measures including soil stabilization and capping; a tidal barrier system to minimize contaminant seeps from the site to the adjacent beach; capping of contaminated sediments; and institutional controls (ICs). The cleanup was completed in 1997. The former shipyard is currently used by the Washington Department of Transportation for maintenance of state ferries. Because the remedy is functioning as designed and no additional actions are planned, OU3 is not discussed further in this document.

### 2.5 History of Enforcement Actions

EPA issued an order requiring the Wyckoff Company to conduct environmental investigations in 1984. In July 1988, EPA ordered the company to install groundwater extraction wells and a groundwater treatment plant to halt continuing releases of wood-treating contaminants to Eagle Harbor. The facility ceased operations in 1988, and the company was re-named Pacific Sound Resources (PSR).

A settlement with PSR was embodied in a Consent Decree entered in Federal District Court in August 1994. The Decree created the PSR Environmental Trust, into which the heirs of the Wyckoff Company founders, owners and operators placed all ownership rights and shares in the Company. This allowed the Trust to maximize liquidation of all company assets. The beneficiaries of the Trust are the United States Department of Interior, the National Oceanic and Atmospheric Administration (NOAA), and the Suquamish and Muckleshoot Tribes as Natural Resource Trustees; as well as EPA (the Superfund trust fund) for reimbursement of CERCLA remedial costs.

**Commented [PHS(2]:** There are no maximum or minimum cleanup levels under new SMS/MTCA.

**Commented [ES(3]:** This is a term from earlier versions of the SMS. We don't use it anymore – it is now referred to as the cleanup screening level (CSL). It would be just fine here because it was used at the time the 1994 ROD was written.

Or, EPA can change MCUL to "Cleanup Screening Levels."

Proceeds from the Trust funded early cleanup activities and natural resource restoration projects, both at the Wyckoff facility and at a sister facility located in Seattle. However, collections from the Trust, which totaled less than $20 million, were dwarfed by substantial cleanup costs at the two facilities. To date, EPA has spent more than $180 million on site investigations and cleanup actions at the Eagle Harbor site. In 2012, EPA conducted a search for additional potentially responsible parties and determined that no other viable parties remained who could be liable for EPA response costs.

## 3 Community and Tribal Participation

EPA and Ecology coordinated closely throughout the development of the OU1 FFS report, and held regular meetings with a community stakeholder group to share investigation results and answer questions from community members. The draft final FFS for OU1, addressing contamination remaining in the intertidal beaches, were made available to the public in April 2016, along with the Proposed Plan for Amending the Records of Decision for the Wyckoff/Eagle Harbor Superfund Site (Operable Units 1, 2, and 4). These as well as other relevant site documents can be found in the Administrative Record for the Proposed Plan. Copies of the Administrative Record are available to the public at the EPA's office in Seattle, at the Bainbridge Island public library, and on EPA's Superfund project web site at: http://www.epa.gov/superfund/wyckoff-eagle-harbor.

Notice of the availability of the Proposed Plan and associated documents was published in the Bainbridge Islander on April 22, 2016, along with notice of a public meeting to be held on April 27. Information about the Proposed Plan and public meeting was sent by email to 553 individuals who had signed up previously to receive project updates by email. A fact sheet summarizing the Proposed Plan and announcing the public meeting was mailed to 875 individuals on the site's mailing list. Notice of the public meeting was advertised in the City of Bainbridge Island's weekly community newsletter. Flyers informing the community about the public meeting were posted at the site and on community notice boards at the grocery store, the ferry terminal, and other high traffic locations. Bloomberg News ran a story about the Proposed Plan and public meeting on April 26.

A public meeting was held at Bainbridge Island City Hall on April 27. The EPA accepted verbal and written comments at the public meeting. The Kitsap Sun ran an article about the Proposed Plan on May 6. The public comment period, originally scheduled to end on May 31, was extended to June 30 after the EPA received a written request to extend the comment period. The EPA's responses to comments received during the public comment period for the Proposed Plan is included in the Responsiveness Summary (Part 3), which is part of this RODA.

Federal, Tribal, and state natural resource trustee agencies participated in the 1994 federal consent decree and used the funds recovered to restore eelgrass habitat east of the former wood treating facility. The EPA has continued to keep the trustee agencies appraised of cleanup efforts and planning and sought input from them on the Proposed Plan. Eagle Harbor is particularly important to the Suquamish Tribe because it is within the Tribe's Usual and Accustomed fishing area. The Tribe, as a sovereign nation, has engaged in government to government consultations with the EPA on the cleanup process and decisions. The EPA will continue to consult with the Tribe throughout design, construction, and long-term monitoring of the remedy.

## 4 Scope and Role of Response Action

This interim RODA modifies the current cleanup decision for three Operable Units – the East Harbor Operable Unit OU1, the Soils Operable Unit OU2, and the Groundwater Operable Unit OU4. It makes no changes to the cleanup decision for the West Harbor Operable Unit OU3.

### 4.1 Changes to the Cleanup Decision for OU1, East Harbor

The cleanup decision currently in place for OU1, East Harbor is described in two decision documents:

- East Harbor Operable Unit, Wyckoff/Eagle Harbor Superfund Site Record of Decision, September 1994 (1994 ROD)
- Explanation of Significant Differences, Wyckoff/Eagle Harbor Superfund Site, East Harbor Operable Unit, September 2007 (2007 ESD)

The 1994 ROD established cleanup goals for all of Eagle Harbor, including both subtidal and intertidal (beach) sediments. Cleanup goals in subtidal areas were to be met through capping. Cleanup goals in intertidal sediments were to be met through MNR. EPA estimated that MNR would require 10 years following implementation of source control actions to halt the release of contaminants from the upland portion of the site to the intertidal beaches.

In the 2007 ESD, EPA modified the cleanup decision, selecting additional chemical-specific cleanup goals for intertidal sediment on West Beach, and changing the cleanup technology on West Beach from MNR to an engineered cap called an EBS. No changes were made to the cleanup decision for the remaining intertidal beaches. As a result, there are currently two cleanup decisions in place for the intertidal beaches.

The Selected Remedy presented in this interim RODA establishes new cleanup levels for intertidal beach sediments within the East Harbor OU, replacing the cleanup levels for the intertidal beaches that were established in both the 1994 ROD and the 2007 ESD. This interim RODA does not change the cleanup levels or the cleanup technology for the subtidal portion (-2.0 feet Mean Lower Low Water [MLLW] and deeper) of the East Harbor OU. In subtidal areas, the cleanup levels remain unchanged from the 1994 ROD, and capping remains the selected cleanup technology. This interim RODA adds a new cleanup technology – dredging and capping – to portions of the East Beach and North Shoal. Outside the dredging and capping footprint, the remedy remains MNR. This interim RODA does not change the cleanup technology for West Beach, where the EBS installed in 2008 is functioning as designed.

### 4.2 Changes to the Cleanup Decision for OU2/4, Upland Soils and Groundwater

The Selected Remedy presented in this interim RODA includes replacement of the steel sheetpile wall and improvements to the access road between Eagle Harbor Drive and the FPA. This decision includes no other changes to the remedy for OU2/4. Additional cleanup actions in OU2/4 will be presented in a future decision document.

Changes to remedial action objectives and chemical-specific cleanup levels are discussed in greater detail in Section 8 of this RODA.

## 5 Site Characteristics

This section describes the physical setting of the Site. It also summarizes the nature and extent of contamination remaining in in the adjacent intertidal beaches (OU1).

5.1 Physical Setting

The former Wyckoff wood treating facility is located on the south shore of Eagle Harbor. The property covers 54 acres, including 13 acres of relatively flat land where historic wood-treating operations occurred (the former process area). The remainder of the property consists of a steeply sloped, wooded hillside. Eagle Harbor Drive, which runs east/west along the top of the slope above the site, is approximately 100 feet above the former process area.

The offshore portion of the site consists of intertidal beaches and subtidal areas of Eagle Harbor. Eagle Harbor is shallow, with maximum depths of -56 feet MLLW. Intertidal beaches extend seaward from the sheet pile wall, ranging in elevation from +5 feet MLLW near the base of the wall to -2 feet MLLW at the northern edge of the shoal. Intertidal sediments consist of interbedded sands, gravels, and silts. Shoaling areas transition to deeper subtidal zones of Puget Sound to the east of the site, and to Eagle Harbor to the north and west.

5.2 Contaminant Transport Pathways

Prior to construction of the perimeter sheet pile wall, creosote and contaminated groundwater in the former process area discharged to Eagle Harbor and Puget Sound. The perimeter wall virtually eliminated further contaminant transport to adjacent intertidal beaches. However, considerable quantities of creosote were left outside the wall, because it was impracticable to enclose all of the contamination beneath the intertidal beaches within the perimeter wall.

Groundwater in the former process area occurs in an upper aquifer and a lower aquifer that are separated by an aquitard – a relatively dense layer of soils including marine silt, glacial deposits and clay. The aquitard is just below the ground surface along the southern edge of the former process area. It slopes steeply downward toward the northern edge of the site, where it is encountered at depths of -70 feet MLLW and deeper. The aquitard greatly slows but does not completely prevent the movement of contamination from the upper aquifer into the lower aquifer. In places, the aquitard is thin or absent altogether and there are layers within the aquitard that contain creosote.

Contaminant transport pathways are summarized in the Conceptual Site Model depicted in Figure 3.

**Commented [PHS(4]:** Double-check the elevation of approx. high tide level depicted in the Figure 3.

5.3 Contaminants of Concern

The primary wood preservative used at the Wyckoff facility was creosote—a thick, oily liquid distilled from coal tar. Creosote contains more than a hundred individual chemicals including PAHs such as naphthalene and benzo(a)pyrene. Creosote in the soil and groundwater occurs primarily in the form of a non-aqueous phase liquid (NAPL). Both light NAPL (LNAPL) and dense NAPL (DNAPL) occur in upland soils. LNAPL is found in the top layers of the upper aquifer, where it moves up and down with seasonal and tidally induced groundwater elevation changes, creating a smear zone of contamination in the soil. LNAPL also occurs in intertidal beach sediment. DNAPL is found in the deeper portions of the upper aquifer.

Pentachlorophenol (PCP) was also used as a wood preservative. PCP is found in LNAPL and in groundwater.

Dioxins/furans were generated at the Wyckoff facility as a by-product when wood contaminated with creosote and other chemicals was burned for fuel. Dioxins/furans are also impurities in PCP. Dioxins/furans are found in soil, LNAPL, and DNAPL.

In the 2000 ROD, the EPA stated that "for the purposes of cleanup, it is assumed that other contaminants are co-located with the PAHs and PCP and will be remediated along with these primary contaminants of concern." This assumption remains true today. Contaminants including PCP and dioxins/furans are co-located with the PAHs, and the PAHs are present primarily in NAPL.

In intertidal beach sediments, the COCs are PAHs and PCP. PAHs were identified as COCs in the 1994 ROD. PCP was identified as an additional COC in the 2007 ESD for West Beach. Metals are COCs in subtidal sediments, but not in intertidal beach sediments. For the purposes of cleanup, it is assumed that PCP and dioxins/furans are co-located with the PAHs, which are present primarily in NAPL. Actions that remove or contain NAPL will also remove or contain PCP and dioxins/furans.

5.5 Nature and Extent of Contamination Remaining in Intertidal Beach Sediment (OU1)

In 2011, ten years after the perimeter sheet pile wall was installed~~,~~ EPA sampled East Beach and North Shoal sediments to determine whether cleanup levels had been achieved. These beaches were the focus of the investigation because they were the only areas where active remedial measures (capping and the exposure barrier system) had not been implemented. Significant improvements were seen, including sharp declines in PAH concentrations and a decrease in the number and severity of NAPL seeps. However, cleanup levels had not been achieved everywhere on the beaches and some NAPL seeps remained. An additional investigation to map the extent of NAPL beneath the beaches (CH2M, 2013b), revealed that:

- NAPL is present in both East Beach and North Shoal subsurface sediments.
- NAPL is not distributed evenly. Most NAPL is in the central part of East Beach and on North Shoal near the former West Dock. The thickest total NAPL accumulations occur near the perimeter sheet pile wall. The volume of NAPL and the thickness of the NAPL layers decreases with increasing distance away from the wall.
- NAPL seeps occur in a few locations. Several of the seeps are persistent and can be found in the same location year after year. The largest seep is on East Beach.

The distribution of NAPL in beach sediments is shown in Figure 4. Recent 2016 sediment sampling conducted in the off-cap area west (200 ft) of West Beach also showed NAPL sheen in a location and showed exceedances of human health criteria of cPAHs.

**Commented [PHS(5]:** What is for the grey-colored thin band at the adjacent to the north shoal and East beach wall in Figure 4?

## 6 Current and Potential Future Land and Groundwater Use

The City of Bainbridge Island purchased the former Wyckoff wood treating facility, with the intent to use the land as a park. The purchase took place in phases over several years beginning in 2004. Most of the property is already in use as a park. Pritchard Park includes hiking trails through the wooded hillside between Eagle Harbor Drive and West Beach, parking lots, and a view point looking east across Puget Sound. The Bainbridge Island Japanese American Exclusion Memorial occupies the far western end of the property. Today, only the former process area remains fenced and inaccessible to the public. The City plans to expand the park to incorporate the former process area once the cleanup is complete. Future land use is anticipated to remain recreational / open space.

Eagle Harbor is within the treaty-protected fishing and shellfish collection area of the Suquamish Tribe, and the Tribe hopes that the beaches can be re-opened for shellfish collection in the future. Intertidal beaches at the site provide important shoreline habitat, supporting forage fish, clams, benthic invertebrates, and shorebirds. A portion of the beach west of the FPA was constructed as habitat mitigation, to compensate for the permanent loss of beach habitat caused by the installation of the

perimeter sheet pile wall. Eelgrass beds that begin at the outer edge of the beaches are particularly important habitat in Puget Sound. Natural resource trustee agencies built two eelgrass restoration areas east of the site. Deeper waters just offshore of East Beach support a state-authorized commercial shellfish growing area, where geoduck and other shellfish may be harvested by the Suquamish Tribe for commercial sale. The beach features discussed here are shown in Figure 5. The anticipated future use of the beaches is recreational beach use, with tribal shellfish collection.

## 7 Summary of Site Risks

Baseline human health and ecological risk assessments were performed for the East Harbor OU in the late 1980s. The results were presented in a 1989 RI report, updated in 1991, and summarized in the 1994 ROD. Human health risks were re-evaluated in 2007 when contamination was discovered in the sediment on West Beach. This evaluation resulted in new, lower cleanup levels to protect recreational beach users on West Beach. The new cleanup levels were included in the 2007 ESD for OU1 (EPA, 2007).

The EPA did not perform a new baseline human health or ecological risk assessment to support more recent site characterization and remedy selection efforts. However, exposure pathways and COCs that were shown to contribute the most risk in the previous evaluations were reevaluated using recent data.

### 7.1~~3~~ Risk from Exposure to Beach Sediments

People could be exposed to contaminants in beach sediments through recreational beach use, when harvesting shellfish, and when consuming shellfish harvested from contaminated sediments. The EPA reevaluated the risk posed by these scenarios to develop cleanup goals for this RODA. Because the site is within the usual and accustomed fishing area of the Suquamish Tribe, Tribal shellfish consumption rates were used in the risk calculations. The greatest risk to tribal consumers, who both collect and eat shellfish, was determined to be from cPAHs. This scenario includes dermal exposure to sediment, incidental ingestion of sediment, and ingestion of clams. The total risk using a Tribal scenario is $4 \times 10^{-1}$. The total risk using a non-Tribal recreational scenario is $1 \times 10^{-2}$. For both Tribal and recreational beach users, most of the calculated risk comes from shellfish consumption, rather than dermal exposure. The risk calculations are summarized in Table 1.

**Commented [PHS(6]:** Table 1 does not seem to match with this statement. Table is for risk calculation of cPAHs only for incidental ingestion/dermal exposure. Please double-check this statement.

Contamination in beach sediments also poses an unacceptable risk to benthic invertebrates—worms, clams, and other organisms that live in the sediment. To evaluate this risk, COC concentrations were compared to the Washington Sediment Management Standards (SMSs). The SMS chemical criteria for protection of marine benthic invertebrates are based on relationships between sediment contaminant concentrations and adverse effects on benthic invertebrates (reduced population size or laboratory toxicity tests showing mortality, reduced growth, or impaired reproduction) using several hundred samples from the Puget Sound area. The methods used to develop the SMS criteria are consistent with CERCLA ecological risk assessment methodology. The SMS~~s~~ include two sets of sediment contaminant concentration goals for protecting benthic invertebrates. The Sediment Cleanup Objective (SCO) concentrations represent a "no adverse effect level," below which adverse impacts on benthic organisms are unlikely. The Cleanup Screening Level (CSL) represents a "minor adverse effect level," above which adverse impacts are more likely to occur.

In the top ten centimeters of sediment in the North Shoal and East Beach, the risk evaluation revealed a few exceedances. Out of five sampling locations on North Shoal, one location had COC concentrations greater than the SCOs. On East Beach, one out of fifteen sampling locations had COC concentrations

above the SCOs. More extensive contamination was found below the beach surface. In samples collected ten centimeters below the surface and deeper, four out of eight stations on East Beach had COC concentrations above the SCOs. A higher number of chemicals exceeded SCO criteria than in the surface, and many chemicals exceeded both the SCOs and the- CSLs~~Cleanup Screening Levels~~.

7.2~~4~~ Basis for Action

The response action in this RODA is necessary to protect the public health and~~or~~ welfare and~~or~~ the environment from actual or threatened releases of hazardous substances into the environment.

Portions of the intertidal beaches have not met the cleanup levels specified in the 1994 ROD, despite more than 16 years of natural recovery following installation of the perimeter sheet pile wall. Persistent NAPL seeps on the beaches, sediment PAH concentrations that exceed cleanup levels, and continued risk from shellfish consumption all support the need for additional cleanup actions on the beaches.

In addition, the perimeter sheetpile wall must be replaced to prevent further contamination of the beaches. The existing wall is rapidly -corroding at risk of structural failure.

## 8 Remedial Action Objectives

In accordance with the NCP, the EPA developed Remedial Action Objectives (RAOs) to describe what the proposed cleanup is expected to accomplish to protect human health and the environment. RAOs help focus the development and evaluation of remedial alternatives and form the basis for establishing cleanup levels.

8.1 Remedial Action Objectives

**Commented [PHS(7]:** Please refer to the ECY comment letter on RAOs.

The five new RAOs for intertidal sediments established by this RODA are listed below. These RAOs replace the RAOs for intertidal sediments established in the 1994 ROD and modified by the 2007 ESD. No changes are proposed to the RAOs for subtidal sediments, which were established in the 1994 ROD. RAOs for intertidal sediments are presented in Table 2 along with the 1994 RAOs and the basis for any changes.

- ~~**Nearshore RAO 1—Prevent risk to human health posed by direct contact with NAPL in surface sediments (defined as the top 10 centimeters) of intertidal beach areas.**~~
- ~~**Nearshore RAO 2—Reduce to protective levels the risk to human health posed by dermal contact and incidental ingestion of contaminated sediments in the top 2 feet of intertidal areas that provide habitat for shellfish.**~~
- ~~**Nearshore RAO 3—Reduce levels of COCs in the top 10 centimeters of sediments to concentrations that protect benthic community health.**~~
- ~~**Nearshore RAO 4—Reduce levels of COCs in shellfish tissue to concentrations that protect Tribal shellfish consumers.**~~

  ~~**Nearshore RAO 5—Prevent risks from consumption of shellfish until protective levels are achieved.**~~

**Formatted:** Indent: Left: 0.25", No bullets or numbering

- **Nearshore RAO 1—Prevent direct exposure to NAPL and r~~R~~educe to protective levels the risk to human health posed by dermal contact and incidental ingestion of contaminated sediments in intertidal beach areas.** This RAO will be met in two ways: 1) when NAPL seeps are no longer

observed on the surface of the beach during visual inspections conducted at low tide. The EPA expects that this objective will be achieved immediately after construction of the Selected Remedy; and 2) when the upper confidence limit on the mean (UCL 95) concentration of COCs in the top two feet of beach sediments is at or below cleanup levels for the protection of human health, provided in Table 4. The point of compliance is the top two feet of sediment over most of the beach areas. In a few areas along the southern edge of the exposure barrier system on West Beach, the cover layer is less than two feet thick; where this is the case, the point of compliance is from the surface down to the cobble layer of the barrier system.

- **Nearshore RAO 2—Reduce levels of COCs in sediments to concentrations that protect benthic community health.** This RAO will be met when the concentration of COCs in the top ten centimeters of sediment, on a point-by-point basis, are at or below cleanup levels for the protection of benthic organisms provided in Table 4.
- **Nearshore RAO 3—Reduce levels of COCs in shellfish tissue to concentrations that protect Tribal shellfish consumers, and prevent risks from consumption of shellfish until protective levels are achieved.** Shellfish tissue COC concentrations are expected to decline following active remedial measures that reduce contaminant concentrations in sediment and porewater. Target tissue concentrations for shellfish are discussed in Section 8.4. Meeting this RAO will also address risks to the shellfish themselves. Shellfish consumption advisories, signage and outreach will be used to reduce risks until target tissue concentrations are achieved.

Commented [PHS(8]: Then, clamming won't be allowed in this area?

Commented [ES(9]: See ECY comment in Table 4 on recommended TOC normalization ranges when evaluating risk to benthic invertebrates.

Formatted: No bullets or numbering

Formatted: Indent: Left: 0", Hanging: 0.25", No bullets or numbering

## 8.2 Cleanup Levels

This section describes the selected cleanup levels for intertidal sediments. The cleanup levels are contaminant concentrations that will be used to measure the success of the Selected Remedy in meeting the RAOs. Cleanup levels are based on applicable or relevant and appropriate requirements (ARARs), which provide minimum legal standards, and other information such as toxicity information from the human health risk evaluation.

Not all the RAOs will be met by achieving specific cleanup levels. Table 3 provides a summary of how achievement of each RAO will be determined. Sediment cleanup levels are presented in Table 4.

## 8.3 ARARs

ARARs are legally applicable or relevant and appropriate substantive (as opposed to administrative) standards, requirements, criteria, or limitations under any federal environmental law, or promulgated under any state environmental or facility siting law that is more stringent than federal law. ARARs are discussed further in Section 10.1.2. A complete list of ARARs is provided in three tables:

- Table 5: Chemical-Specific ARARs
- Table 6: Action-Specific ARARs
- Table 7: Location-Specific ARARs

Commented [PHS(10]: Ecology made a few corrections/edits on these tables.

These tables include ARARs for both the sediment cleanup actions that are the subject of this RODA, and additional planned cleanup actions that will be presented in a separate RODA.

In intertidal sediments, the most significant ARARs for developing cleanup levels for OU1 are in the SMS rules for sediment in WAC 173-204, which are referred to in the MTCA general cleanup rules (WAC 173-340-760).

Sediment cleanup levels for Sediment RAO ~~2~~ 1 (protection of human health from direct contact and incidental ingestion of~~with~~ sediment) are calculated at the SCO level. The cleanup levels are risk-based threshold concentrations (RBTCs) for COCs resulting in a 1 x $10^{-6}$ excess lifetime cancer risk for the ~~individual~~ sum of seven carcinogenic PAHs and for other individual carcinogens~~ens~~. Sediment cleanup levels for Sediment RAO ~~2~~3 (protection of benthic invertebrates) are based on the SCO for the protection of benthic invertebrates (benthic SCO) of the SMS which are defined by chemical and biological criteria for specific hazardous substances.

If long-term monitoring data and trends indicate that some cleanup levels or other ARARs cannot be met, the EPA will determine whether further remedial action could practicably achieve the ARAR. If the EPA concludes than an ARAR cannot be practicably achieved, the EPA will waive the ARAR on the basis of technical impracticability (TI) in the final ROD for the Site.

8.4 Shellfish Target Tissue Concentrations

The EPA has established shellfish target tissue concentrations to measure progress toward achieving Sediment RAO ~~3~~4. Actions to minimize the release of COCs from the upland area to the intertidal beaches, in combination with active remedial measures in the beaches, will reduce COC concentrations in sediment and in porewater. These reductions are expected to result in declining contaminant concentrations in shellfish tissue. The target concentration for cPAHs is 0.12 µg/kg [benzo(a)pyrene] TEQ[1] in the edible tissue of resident clams. This concentration represents the background concentration of cPAHs in clam tissue collected from nonurban locations in Puget Sound. This concentration is ~~still~~ higher than the risk-based concentration of 0.050 µg/kg [benzo(a)pyrene] TEQ that would protect Suquamish Tribal shellfish consumers. The EPA selected the background concentration because achieving tissue concentrations below background is not possible.

The data set used to generate the background concentration is small, so the background concentration is uncertain. The EPA will continue to monitor tissue concentrations at the site and collect clams from background locations to develop a more robust background data set. If long-term monitoring data and trends indicate that the target tissue concentration cannot be achieved, the EPA will determine whether further remedial action could practicably achieve lower tissue concentrations. The EPA may also determine that the target tissue concentration should be adjusted, based on additional background data. Any changes to the target tissue concentration or additional cleanup actions will be documented in a future decision document (*e.g.,* the final ROD for OU1 or for the Site).

## 9 Description of Alternatives

As explained in Section 7.24 - Basis for Action above, EPA determined that additional cleanup actions are necessary to protect human health and the environment. This section presents and describes the remedial alternatives that were developed and evaluated.

9.1 Remedial Alternatives Considered

**Commented [ES(11]:** Please note Ecology's stance that a final sediment cleanup level for protection of human health will need to take into account a Tribal fish/shellfish consumption scenario, as specified in the "reasonable maximum exposure" criteria in WAC 173-204-561 ("Sediment cleanup levels based on protection of human health").

**Commented [PHS(12]:** per MTCA WAC 340-708((8)(e).

**Commented [BH13]:** Use a footnote here to define cPAH TEQ: cPAHs consist of a subset of seven PAHs which EPA has classified as probable human carcinogens: benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Individual PAH concentrations were summed, using compound-specific potency equivalency factors, resulting in a calculated carcinogenic PAH total (cPAH TEQ) for each sediment sample.

The alternatives considered to address contamination in the intertidal sediments are summarized below; more details are available in the Proposed Plan and the FFS. A full description of the Selected Remedy is provided in Section 13 of this RODA.

9.1.1 Nearshore Alternative 1 – No Further Action

| | |
|---|---|
| **Estimated Capital Costs: $0** | **Estimated Construction Timeframe: N/A** |
| **Estimated O&M Costs: $0** | **Estimated Time to Achieve RAOs: More than 20 years** |
| **Total Estimated Present Value: $0** | |

Under Nearshore Alternative 1, no further actions would be taken to address the NAPL contamination remaining in the beaches. The current remedy for the beaches, MNR, would remain in place. The cleanup goals would remain unchanged from the 1994 ROD, as amended by the 2007 ESD. Monitoring of all of OU1, including both the subtidal sediment cap and the intertidal beaches would continue. MNR is expected to continue, resulting in further declines in contaminant concentrations. However, the beaches are unlikely to meet the RAOs within 10 years, particularly on East Beach, where the most significant and persistent NAPL seeps remain.

9.2.2 Nearshore Alternative 2 – Seep Capping

| | |
|---|---|
| **Estimated Capital Costs: $2,610,000** | **Estimated Construction Timeframe: 2 months** |
| **Estimated O&M Costs: $500,000** | **Estimated Time to Achieve RAOs: 15 to 20 years** |
| **Total Estimated Present Value: $3,110,000** | **Excavation/dredge volume: 900 cubic yards** |

Nearshore Alternative 2 includes small cap "patches" approximately 40 feet by 40 feet in size over active seep areas in the beaches; there are four known active seep areas. These four areas would be remediated, along with up to two additional seeps. This would result in active remediation over 0.3 acres of beach habitat. The remaining 10.5 acres would be addressed through MNR.

Seep areas would be remediated by removing the top 30 inches of sediment and replacing the material with a permeable reactive cap. The cap would consist of three layers:

- A 4- to 6-inch thick layer of reactive materials at the bottom of the excavated area
- A demarcation layer
- Clean sand above the demarcation layer

The reactive layer would contain oleophilic clay or other reagents to intercept and adsorb NAPL and PAHs flowing upward through the cap. The demarcation layer would discourage digging below it and provide a visual reference to aid future replacement or repair efforts, should they be needed. Specific materials for the reactive layer and the demarcation layer would be evaluated and identified during design. The clean sand would be approximately 2 feet thick, and it would be graded to match the beach around it so that there would be no change in the beach elevation as a result of the remedy.

O&M activities would include monitoring to ensure the capped areas remain in place and that they effectively prevent exposure to remaining subsurface contamination. The reactive layer of the cap may require replenishing if breakthrough is observed. The cost estimate assumes that 25 percent of the

capped areas would require replenishment in Year 9, and 12 percent would require replenishment again in Year 30.

9.2.3 Nearshore Alternative 3 – Partial Excavation/dredge and Capping (Selected Remedy)

| | |
|---|---|
| **Estimated Capital Costs: $8,920,000** | **Estimated Construction Timeframe: 4 months** |
| **Estimated O&M Costs: $2,850,000** | **Estimated Time to Achieve RAOs: 10 to 15 years** |
| **Total Estimated Present Value: $11,770,000** | **Excavation/dredged volume: 6,~~5~~600 cubic yards** |

**Commented [PHS(14]:** Wet volume is 6,450 cy. Double check the accuracy ofwet volume.

Nearshore Alternative 3 is the Selected Remedy for the intertidal areas of OU1. This alternative will apply the same technology and construction technique as Alternative 2, but over a larger area. The cleanup footprint includes all areas of the beaches with NAPL in the top 3 feet of sediment. The Selected Remedy will actively remediate approximately 1.6 acres; the remaining 9.2 acres will be addressed through MNR. O&M requirements are the same as described for Alternative 2.

**Commented [PHS(15]:** Is this final/estimated area of excavation/capping area?

9.2.4 Nearshore Alternative 4 – Vertical Containment with Partial Excavation and Capping

| | |
|---|---|
| **Estimated Capital Costs: $12,840,000** | **Estimated Construction Timeframe: 4 months** |
| **Estimated O&M Costs: $2,380,000** | **Estimated Time to Achieve RAOs: 10 to 12 years** |
| **Total Estimated Present Value: $15,220,000** | **Excavation/dredge volume: 6,600 cubic yards** |

Nearshore Alternative 4 is similar to Nearshore Alternative 3, but with an added remedial component—vertical containment walls. Vertical containment walls would prevent further lateral movement of NAPL outward, away from the existing sheet pile wall to the outer portions of the beaches. Reducing the flow of NAPL could increase the recovery rate in the areas managed using MNR.

The vertical containment walls would be constructed of interlocking steel sheet piles that would extend from just below the surface of the beach to a depth of 20 feet below the mudline. They would encircle areas of subsurface NAPL and attach to the existing perimeter wall. Areas inside the vertical containment walls would be capped, using the three-layer permeable reactive cap as described for Alternatives 2 and 3. This alternative would actively remediate approximately 1.6 acres; the remaining 9.2 acres would be remediated through MNR. O&M requirements are the same as described for Alternative 2.

9.2.5 Nearshore Alternative 5 – Dredging

| | |
|---|---|
| **Estimated Capital Costs: $28,960,000** | **Estimated Construction Timeframe: 8 months** |
| **Estimated O&M Costs: $420,000** | **Estimated Time to Achieve RAOs: 10 years** |
| **Total Estimated Present Value: $29,370,000** | **Excavation/dredge volume: 26,000 cubic yards** |

Nearshore Alternative 5 would involve dredging and removing contaminated sediment and NAPL to a depth of 10 feet in portions of the North Shoal and East Beach areas. This would remove most NAPL present in the top 10 feet from the beaches. This alternative would actively remediate approximately 1.6 acres; the remaining 9.2 acres would be remediated through MNR. Excavated areas would be

backfilled to grade with clean sand. To address NAPL left below the 10-foot excavation depth, a layer of oleophillic clay would be placed at the bottom of the excavation prior to backfilling.

O&M costs for Nearshore Alternative 5 would be limited to monitoring. No replenishment of the capping materials would be performed.

## 10 Summary of Comparative Analysis of Alternatives

EPA used the nine criteria required by CERCLA and the NCP to evaluate and select the remedy to address contamination remaining in the intertidal beaches. This section discusses the relative performance of each alternative against the nine criteria, noting how the Selected Remedy compares to the other alternatives. The nine criteria are in three categories: threshold criteria, balancing criteria, and modifying criteria.

### 10.1 Comparative Analysis of Alternatives for the Intertidal Beaches (Operable Unit 1)

10.1.1 Overall Protection of Human Health and the Environment: Meeting RAOs

All alternatives, except Nearshore Alternative 1, would protect human health and the environment through varying combinations of dredging, capping, and Monitored Natural Recovery (MNR). All the active alternatives would provide a substantial reduction in risk when compared to baseline conditions. Nearshore Alternative 2 would take the longest amount of time to meet RAOs, because it relies most heavily on MNR.

10.1.1.1 Prevent Direct Human Exposure to NAPL and Reduce Risks from Dermal Contact and Incidental Ingestion - Nearshore RAO 1

**Commented [PHS(16]:** Ecology revised per three consolidated RAOs.

Nearshore Alternatives 2 through 5 include dredging and capping of the beach areas where NAPL is present in the top 2 feet, so all of them would meet RAO 1 immediately following construction. Of the active treatment options, Alternative 2 is mostly likely to require future maintenance. Alternative 2 treats small, focused areas on the beaches, which could allow NAPL seeps to move around the capped areas and re-appear in uncapped areas nearby. Alternatives 3, 4, and 5 treat larger, more continuous areas.

~~10.1.1.2 Reduce Risks from Dermal Contact and Incidental Ingestion – Nearshore RAO 2~~

Meeting Nearshore RAO 1~~2~~ will require cleanup actions that achieve specific concentrations of chemicals in the top 2 feet of sediment where human exposure may occur. Alternatives 3, 4, and 5 would achieve this RAO in the shortest amount of time, because they treat the largest area with dredging and capping. Alternative 2 would require the longest time to meet RAO 1~~2~~ because of its smaller treatment area and greater reliance on MNR.

10.1.1.2~~3~~ Protect the Benthic Community – Nearshore RAO 2~~3~~

Nearshore Alternatives 3, 4 and 5 are most likely to meet RAO 2~~3~~ quickly because they treat the largest area, and will replace contaminated sediment with clean, imported material.

10.1.1.3~~4~~ Reduce COC Concentrations in Shellfish Tissue and Prevent risks from Shellfish Consumption until Protective Levels are Achieved – Nearshore RAO 3~~4~~

Nearshore Alternatives 3, 4, and 5 are most likely to achieve the target tissue concentration in shellfish because they remove the largest mass of COCs from the depth interval where shellfish reside. Under Alternative 5, there is less potential for re-contamination because any COCs left in place would be unlikely to move through the 10 foot thick cap to re-contaminate surface or shallow subsurface sediments.

~~10.1.1.5 Prevent risks from Shellfish Consumption until Protective Levels are Achieved – Nearshore RAO 5~~

All of the alternatives, except Nearshore Alternative 1, rely on shellfish tissue monitoring, consumption advisories, and warnings to prevent human exposure through consumption.

10.1.2 Compliance with ARARs

In the intertidal beaches, RAOs will be met through a combination of dredging/excavation, capping, and MNR. All of the alternatives use MNR to achieve sediment cleanup levels outside the treatment areas. MNR has been effective to date. Before the perimeter sheet pile wall was installed, COCs moved from the upland portion of the site to the beaches on a continual basis. NAPL seeps were frequent and widespread, and sheens could be observed at low tide over most of the East Beach and North Shoal areas. Today, only a few persistent NAPL seeps remain, and sheens and odor are also less common. The Exposure Barrier System constructed on the West Beach has performed well to date; contaminant concentrations have remained below cleanup goals. These findings support EPA's determination that MNR is likely to continue to be effective on East Beach and North Shoal, particularly after cleanup actions remove source material (NAPL) from the top 2 feet of the beaches. However, it is difficult to predict the rate of natural recovery. Complying with ARARs may be most challenging in areas slated for MNR. The most significant ARARs for in-water / nearshore cleanup work are the MTCA / SMS requirements.

The following subsections summarize the comparative evaluation of the nearshore alternatives against the balancing criteria to identify the major trade-offs.

10.1.3 Long Term Effectiveness and Permanence

All of the alternatives would leave NAPL contaminated material at depth. Alternative 5 would be the most permanent and effective option in the long term, because of the large volume of contaminated sediment removed from the marine environment. Alternatives 2, 3, and 4 would be more likely to require repair or replacement of cap sections, because the caps are thinner – 2 feet thick, instead of the 10 foot thick caps in Alternative 5.

10.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

All of the nearshore alternatives, except Alternative 1, assume landfill disposal of the dredged sediment, with treatment only if needed to meet solid waste landfill disposal requirements. Alternatives 2, 3, and 4 include a top layer of sand underlain by a reactive layer of activated carbon, oleophillic clay, or both. Testing during remedial design will inform the final choice of treatment materials. Other treatment options to reduce toxicity, mobility, and/or volume were eliminated from consideration in a technology screening evaluation prior to the FFS.

10.1.5 Short-Term Effectiveness

Alternative 3, 4, and 5 would be the most effective in reducing short-term risks because they address the largest surface area of the active treatment alternatives. Alternative 5 would remove a larger volume of contaminated sediment from the marine environment, but the temporary coffer dams required would damage nearby habitat, including sensitive eelgrass habitat.

10.1.6 Implementability

Alternative 2 would be the easiest to implement and could be completed quickly, in just 2 months. Alternatives 3 and 4, which would dredge and cap larger, more continuous areas of the beaches, would take approximately 4 months to construct. Alternatives 2, 3, and 4 would use land-based equipment driven out onto the beaches at low tide. It may be difficult to dredge and backfill, especially along the outer edges of the treatment areas. The farther out on the beach, the shorter the low-tide work window, and the harder it will be to keep excavated areas from collapsing. This may limit the effectiveness of these alternatives, especially Alternatives 3 and 4. Alternative 5 would be very challenging to implement. Dredging and backfill activities would have to be done inside of temporary coffer dams sturdy enough and deep enough to hold water during low tides; this would require the work to be done from barges inside the coffer dams.

10.1.7 Cost

Capital costs and operations and maintenance (O&M) costs, and 100-year net present value (NPV) costs for each remedial alternative, calculated with a 7% discount rate (as required by EPA guidance), are provided in Table 8. The estimated cost of $11.8 million for the selected alternative falls in the middle of the cost range for the FFS alternatives evaluated ($3.1 to $29.4 million).

Table 8 also provides capital costs for replacement of the perimeter sheet pile wall, and for improvements to the access road. These "common elements" add additional costs of $24.6 million to each of the remedial alternatives assuming temporary sheetpile wall is necessary for constructing permanent concrete bulkhead.

**Commented [PHS(17]:** This is based on the discussion with Corps last November. Ways/means can be found by the selected contractor. EPA delete this edit ECY made.

The total cost of the Selected Remedy, including Alternative 3 -Partial Excavation and Capping and the common elements, is $36.4 million.

10.2 Modifying Criteria Evaluation

This section summarizes the comparative evaluation of the upland and intertidal alternatives based on the modifying criteria of Community Acceptance and State/Tribal Acceptance. The EPA received comments on the Proposed Plan from 53 individuals and organizations, including the City of Bainbridge Island, the Suquamish Tribe, and state government agencies including the Washington Department of Ecology.

10.2.1 Community Acceptance

Only a few comments were received on the preferred alternative for the intertidal beaches. Commenters expressed concern with how the caps will be maintained and monitored given the possibilities for heavy flooding, beach erosion, and log induced scour. They also questioned how perimeter drains proposed as part of upland cleanup activities might impact the beaches.

A summary of the all the comments received on the Proposed Plan and EPA's responses are provided in Part 3 of this RODA.

10.2.2 State/Tribal Acceptance

The Washington Department of Ecology concurs with the selected core remedy for the upland and intertidal areas. A copy of their concurrence letter is provided as Attachment 1.

Eagle Harbor is within the Suquamish Tribe's ususal and accustomed area for fishing and shellfish collection. The Tribe actively manages aquatic resources in and outside of Eagle Harbor, including commercial shellfish beds just east of the harbor in the deeper waters of Puget Sound. In their comments on the Proposed Plan, the Tribe echoed many community comments on the slow pace of the upland cleanup, urging EPA to consider ways to accelerate remedial construction schedule. Relative to the intertidal area, the Tribe requested that contaminated sediments dredged from the beaches be disposed in an offsite landfill and not stabilize/cap in the upland portion of the site, as suggested as an option in the Proposed Plan.

10.3 Summary of CERCLA Nine Criteria Evaluation

For the intertidal beaches, Alternative 3 was identified as the highest ranked alternative. Nearshore Alternative 2 was judged to be insufficient, because it would treat too small of an area to make a substantial difference in contaminant concentrations. The subsurface containment wall in Nearshore Alternative 4 raised many concerns (for example, that erosion would expose the tops of the walls, leaving a hazard to boaters and beachgoers and affecting natural sediment transport patterns). In EPA's judgement, the potential benefit of removing a larger volume of contaminated sediment under Nearshore Alternative 5 was not commensurate with its high cost, greater implementation challenges, and short-term damage to eelgrass beds and other intertidal habitat features.

## 11 Principal Threat Waste

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site whenever practicable (40 CFR 300.430[a] [1] [iii] [A]). In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or will present a significant risk to human health or the environment should exposure occur.

In the 1994 ROD for OU1, EPA determined that "The principal threat in the East Harbor is defined as subtidal sediments containing free-phase oily contamination." This determination has not changed. Sediments contaminated with oily creosote, described in this RODA as NAPL contaminated sediments, are principal threat waste.

The cleanup decision described in this RODA requires dredging/excavating to remove NAPL contaminated sediment from the top two feet of the intertidal beaches. Dredged sediment will be treated if necessary to reduce contaminant mobility prior to transport and disposal in a landfill. Treatment of the remaining NAPL contaminated sediment will be accomplished through the use of reactive materials the bottom layer of the cap. The reactive materials will reduce contaminant mobility and help ensure containment of contaminants that will be left beneath the cap.

**Commented [PHS(18]:** It would be good to have both ways/means stated here.

## 12 Documentation of Significant Changes to the Selected Remedy

After the Proposed Plan was issued in April 2016, two changes were made the Selected Remedy.

Change 1 - Cleanup Levels

~~Sediment:~~ In 2017, EPA issued a new cancer slope factor for benzo(a)pyrene (EPA 2017). To ensure the cleanup decision is based on the most current scientific data, the human-health based risk assessment calculations used to determine sediment cleanup levels for direct contact and incidental ingestion (Nearshore RAO 2) and the target tissue concentration for shellfish (Nearshore RAO 3~~5~~) were updated (EPA 2018).

Sediment: For sediment, this evaluation resulted in a new cleanup level for benzo(a)pyrene, and for cPAHs [benzo(a)pyrene] TEQ. The preliminary remedial goal identified in the Proposed Plan for both of these constituents was 63 µg/kg dry weight; the final cleanup level is 461 µg/kg dry weight (cPAHs, TEQ) based on the Tribe's~~s'~~ dermal and incidental ingestion of sediment.

Tissue: There was no change to the target tissue concentration for cPAHs in shellfish tissue, because the new risk-based target tissue concentration of 0.05 µg/kg [benzo(a)pyrene- cPAHs] TEQ is still lower than the Puget Sound natural background concentration of 0.12 µg/kg [benzo(a)pyrene ~~or~~ cPAHs] TEQ. The final target tissue concentration goal is the background concentration of 0.12 µg/kg [benzo(a)pyrene~~or~~ cPAHs] TEQ.

Change 2 - Intertidal Remedy – Disposition of Dredged Sediments

In the Proposed Plan, EPA presented a modification to Alternative 3, to include offsite versus upland disposal of dredged sediments. In response to comments, this modification has been dropped. Dredged sediments will be transported offsite for disposal in a landfill as described in the following section of this RODA.

Change 3 - Outboard construction of new concrete reinforced permanent perimeter wall

EPA has selected outboard (seaward) configuration of new wall instead of inward configuration due to the reduction of cost, uncertainty, and implementation issues due to the generation of large amount of debris. The outboard wall alignment would result in the loss of 0.2 acre of beach habitat (aquatic land) and would require mitigation which will be addressed during the JARPA process.

## 13 Selected Remedy

Based on consideration of CERCLA requirements, the detailed analysis of remedial alternatives, and public comments, EPA has selected Alternative 3 - Partial Excavation and Capping - as the interim remedy for the intertidal beaches.

The selected remedy is described in detail below.

### 13.1 Summary of the Selected Remedy for the Nearshore Beaches

The Selected Remedy for the Nearshore Beaches, depicted on Figure 6, consists of:

- Pre-design sampling to finalize treatment areas in portions of the North Shoal;
- Active treatment (dredging/excavation and capping) of approximately 1.6 acres of sediment;
- Excavation of approximately 6,600 cubic yards of NAPL contaminated sediments from the active treatment areas to a depth of approximately 2.5 feet;
- Installation of a multi-layer cap in the dredged areas, consisting of a 4 to 6 inch thick reactive layer, an optional demarcation layer, and a 2 foot thick habitat layer;
- MNR in the 9.2 acre area outside the active treatment areas;

**Commented [PHS(19]:**

**Commented [PHS(20]:**

**Commented [ES(21]:** Ecology recommends early consultation with USACE (NOAA, fish and wildlife, tibes, and other resource agencies) to evaluate whether they would consider removal of the West Dock pilings as an acceptable form of mitigation – if EPA plans to propose this as a form of mitigation.

**Commented [PHS(22]:** It would good to leave both options (dredging/excavation) for sediment removal.

**Commented [PHS(23]:** Can we go more than 1.6 acre area of sediment treatment if found to be more than that during the pre-design sampling?

**Commented [PHS(24]:** Why is the demarcation layer optional?

**Commented [PHS(25]:** is this gravelly sand?

- Institutional controls—A uniform environmental covenant and/or deed restriction would be established, as needed, to prevent future marine construction projects from impacting the capped portion of the beaches.
- Shellfish advisories and warnings—Until such time as contaminant concentrations in shellfish tissue are low enough to support unrestricted harvest and consumption. EPA would coordinate with the Washington Department of Health on the issuing and publication of shellfish consumption advisories; and
- Replacement of sections of the caps if needed in the future to maintain the remedy's protectiveness.
- ~~Repair of West Beach area:~~

Additional information on primary elements of the nearshore selected remedy is provided in the following subsections.

Pre-design Sampling

Treatment areas were selected based on multiple lines of evidence, including TarGOST data showing the area, depth and thickness of NAPL contamination; the location of persistent seeps; and the likelihood of human exposure. On the East Beach, clean areas were identified outside the target cleanup areas, providing a well justified cleanup boundary. On North Shoal, TarGOST stations were more widely spaced and there were areas where cleanup boundaries could not be determined. These areas will be further evaluated using TarGOST during pre-design sampling. The data will be evaluated using best professional judgement and the following decision rules used to define the final cleanup boundary:

- Areas with TarGOST readings of 50% RE or higher in the top 3 feet of sediment should be dredged and capped.
- Regardless of the TarGOST results, if a co-located confirmatory sediment core sample contains NAPL or oil coated sediment in the top 3 feet, the area should be dredged and capped.
- Areas with significant NAPL contamination below 3 feet should be dredged and capped because they could be a source of contamination to the cleaner layers above them. Capping will reduce contaminant transport to the cleaner layers near the surface though the use of amended layers at the base of the cap. In defining areas of "significant NAPL contamination," EPA will evaluate the depth of the NAPL, the thickness of the NAPL layer and the %RE as follows:
  - NAPL that occurs at depths between 3 and 5 feet below the surface should be capped if the TarGOST response is greater than 100 %RE or it has a thickness greater than 1 foot.
  - NAPL that occurs at depths between 5 and 10 feet below the surface should be capped if the TarGOST response is greater than 150 %RE or it has a thickness greater than 1 foot.
  - NAPL that occurs at depths 10 feet below the surface and deeper does not need to be capped.
- Areas with persistent seeps at the surface should be capped, regardless of the TarGOST data nearby.
- The likelihood of human exposure should be considered. On the East Beach, the area exposed on most days (except during unusually low tides) is a fairly narrow strip next to the sheet pile wall. This factor may be used to justify the inclusion of "borderline" stations (for example, with a TarGOST response less than 50 %RE in the top 3 feet) in the cleanup area boundary.

**Commented [PHS(26]:** 10%RE = 0.5% creosote; 50% RE = mobile NAPL presence.

Please check with CH2 that this RE value is still valid for the criterion for removal or not to removal?

Pre-design sampling will include waste characterization testing, which is needed to ensure requirements for transportation and off-site landfill disposal are met. Pre-design sampling will also include baseline surveys for bathymetry, habitat conditions, and COC distribution.

Active Treatment – Dredging/Excavation and Capping

EPA may select different construction methods during design, but in the FFS EPA assumed cleanup construction will be conducted using conventional land-based (excavation) construction equipment at low tide, when the beaches are exposed. Sediment dredging and capping activities would be conducted in stages over small, discrete areas, to allow both dredging and capping (or backfilling) during a single low tide cycle. Daily tides would constrain construction such that caps would need to be built in relatively small (for example, approximately 40-foot by 40-foot) sections that are contiguous, with approximately 10 percent overlap, across the defined areas. In areas higher up on the beach, it is expected that the daily tidal cycle would allow for longer working periods and allow larger segments to be capped at any one time.

Temporary well points or sump pumps may be needed to keep excavations dry enough to confirm removal depths and to place cap materials with sufficient accuracy. Water pumped from the dredging excavations would be handled at~~in~~ the existing groundwater extraction system in the~~of~~ upland portion of the site.

Excavated sediment will be dried or stabilized as necessary to remove water, then transported to an offsite landfill for disposal.

Contaminated sediment will be removed to a depth of 30 inches. The excavated areas will then be backfilled with a permeable reactive cap. The cap, depicted in Figure 6 would consist of three layers:

- A 4- to 6-inch thick layer of reactive materials at the bottom of the excavated area
- An optional demarcation layer
- Clean sand and/or gravel above the demarcation layer, to match the surrounding beach substrate

**Commented [PHS(27]:** Why optional?

The reactive layer will contain oleophilic clay or other reagents to intercept and adsorb NAPL and dissolved phase PAHs upwelling from lower depths. The demarcation layer, if and where employed, will discourage digging below it and provide a visual reference to aid future replacement or repair efforts, should they be needed. Specific materials for the reactive layer and the demarcation layer will be evaluated and identified during remedial design. The clean gravelly sand would be approximately 2 feet thick, and it would be graded to match the existing beach elevation around it so that there would be no change in the beach elevation as a result of the remedy.

In four specific areas of the beach (at FFS sampling locations 2, 8, 27, and 110), NAPL extends slightly below the general excavation depth of 30 inches. In these areas, the excavation will be extended, if feasible, to the depth of NAPL contamination. Removing all the NAPL from these areas would reduce the need for replenishment of the cap's reactive layer in the future. O~~e~~r the active media thickness may be increased to add additional sorptive capacity to the cap.

**Commented [ES(28]:** What about similar areas that may be identified during pre-design sampling? Will excavation be extended if feasible in those areas?

~~While the intent is to excavate sand to install the cap, if NAPL is encountered at the~~

~~bottom of the excavation, additional impacted sand volume may be removed, or the active media thickness~~
~~may be increased to add additional sorptive capacity to the cap.~~
The top surface of the habitat layer will match the surrounding beach in elevation and will be constructed using materials with a similar grain size as the existing beach.

Monitored Natural Recovery (MNR) and Post-Monitoring

The Selected Remedy uses MNR to achieve RAOs in the areas outside the active cleanup footprint. MNR was previously selected as the remedy for the intertidal beaches in the 1994 ROD. The EPA estimated that ten` years of MNR would be required following source control actions in the upland part of the site. Following installation of the upland sheet pile wall, MNR has been effective, and much of the intertidal beach area already meets RAOs. Within the dredging and capping footprints, NAPL remaining near or just below the surface results in exceedances of sediment cleanup goals.

The Selected Remedy will remove NAPL contaminated sediments from the upper layer of the beaches and replace it with clean, imported materials. Amended materials in the bottom of the backfill layer will minimize the movement of NAPL at depth from moving up into the habitat layer of the cap. By removing NAPL, the Selected Remedy will create the conditions under which MNR can be effective. Although it is difficult to predict, the EPA estimates that after the additional planned remedial construction for both upland and nearshore remedial actions is complete, up to ten years of MNR will be needed to achieve cleanup goals throughout the intertidal beaches.

As described in Proposed Plan, EPA plans to conduct the monitor per the existing Operations, Maintenance, and Monitoring Plans for OU 1 (HDR, et al, 2011) which would be modified to reflect the new nearshore remediated areas and the MNR areas per RODA until to meet the final Remediation goals. The monitoring program will includes surveys to assess the physical stability of all nearshore area and visual assessment of NAPL seeps. The monitoring program also includes chemistry for sediment and clam tissues, and biological test to document attainment of cleanup objectives in consultation with Ecology, the Suquamish Tribe and other agencies relevant.

Future Cap Repair

The caps do not require routine maintenance; however, the sorptive media and other cap materials may require replenishing over time if breakthrough is noted during the 100-year performance monitoring period. For cost estimating purposes, it is assumed that 25 percent of the capped area in the North Shoal (18,000 SF) and 25 percent of the capped area in the East Beach (18,000 SF) would require ~~replacement~~ replenishment in Year 9. In addition, 25 percent of the capped area in the East Beach (18,000 SF) would require ~~replacement~~ replenishment in Year 30. A second ~~replacement~~ replenishment event for the East Beach is included because there are more persistent seeps and wave erosion than on the North Shoal.

If repair of any of the cap material ~~or area~~ is required, excavated material would be temporarily stored in the upland portion of the site until it could be stabilized and prepared for offsite disposal. During each of the year 9 and year 30 cap repair mobilizations, it is assumed that the water from dewatering would be containerized, settled, and disposed offsite, because the GWTP will no longer be available.

**Formatted:** Normal, Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

**Commented [PHS(29]:** Do we have any basis to support 10 years of MNR time? Is this based on 2011 year 17 data results- 97% reduction in cPAHs sediment concentrations in the 10-year period (2001 to 2011) following installation of sheet pile perimeter wall?

**Commented [PHS(30]:** Herein, does the source control mean "perimeter wall and ISS construction?"

**Commented [PHS(31]:** "Replenishment" due to erosion/seep would be more appropriate wording instead of replacement? Check it out.

13.2 Summary of the Selected Remedy for Replacing the Perimeter Wall and Improving the Access Road

As described in Section 2.2, contaminated upland soils, mobile NAPL, and groundwater are currently contained by a temporary perimeter steel sheet pile wall. The existing sheet pile wall was designed to be a temporary structure. A perimeter wall was needed during implementation of the steam enhanced extraction remedy selected for upland soil and groundwater in the 2000 ROD. Corrosion protection was not included in the design of the sheet pile wall because it was assumed that once cleanup goals were met, the wall would no longer be needed. The wall has experienced an unusually high rate of corrosion in the intervening 17 years, and is at risk of catastrophic structural failure.

A new permanent concrete reinforced perimeter wall is needed to maintain containment of mobile NAPL and contaminated soil and groundwater. A new wall is also needed to support additional upland cleanup actions planned to address NAPL contamination remaining in upland soil and groundwater. Upland cleanup actions were discussed in the Proposed Plan, and will be presented in a separate, forthcoming RODA for OU2/4. Remedial alternatives considered by EPA for upland soil and groundwater all included a new perimeter wall as a "common element." A replacement wall is included in this RODA, which primarily addresses cleanup of the intertidal beaches, because upland soil, mobile NAPL, and groundwater is a potentially significant source of contamination to the beaches. No remedy in the intertidal beaches could be effective without the continued containment provided by the perimeter wall.

The FFS for OU2/OU4 describes the conceptual design for a new perimeter wall as a steel reinforced concrete wall. In the draft FFS and Proposed Plan of 2016, EPA assumed the new wall would be constructed inside the existing wall. The Proposed Plan discussed an outboard (seaward) configuration as an option. EPA has selected the outboard configuration. Building the new permanent wall seaward of the current wall will reduce the cost, uncertainty, and implementation challenges posed by a debris that is buried on the inside of wall. A large quantity of buried debris would need to be removed to accommodate an inboard configuration.

The new wall will be designed to contain upland soils, both now and after implementation of additional cleanup actions planned in the upland portion of the site. It will also be designed to withstand saltwater corrosion, the erosive forces caused by currents, and anticipated sea level rise.
The estimated cost of the replacement wall is $24.3 million.

Improvements to the access road between Eagle Harbor Drive and the FPA are also included in this RODA. The improvements, which will reduce the steep grade over a portion of the road and straighten a sharp curve, are needed to transport large construction equipment and materials to the work area.

The estimated cost of improvements to the access road is $306,000.

13.3 Mitigation plan to compensate due to the construction of new permanent wall in seaward configuration.
JARPA should address the impacts and subsequent mitigation efforts that must be undertaken for the loss of water bodies present on the site.

13.4 Time Line for Selected Remedies (Part 1)

**Commented [PHS(32]:** It would be good to provide a frame work for the timing of key elements of RODA - schedules of pre-design sampling effort, remedial design and remedial action described in this RODA in conjunction with part 2 of RODA. see the ECY letter of comments attached.

## 14 Statutory Determinations

Under CERCLA §121 and the NCP §300.430(f)(5)(ii), the EPA must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

### 14.1 Protection of Human Health and the Environment

In the intertidal beaches, the remedy will protect human health and the environment through actions to excavation/dredge and remove NAPL-contaminated sediments and to backfill dredged areas with clean materials. Where NAPL will be left the below the bottom of the excavation footprint, a sorptive layer will minimize or eliminate the upward migration of contaminants. In areas outside the active treatment footprint, natural recovery processes will reduce contaminant concentrations in sediment, which in turn will reduce contaminant concentrations in shellfish tissue. Because the rate of MNR is difficult to predict, and because the relationship between sediment and shellfish tissue concentrations is poorly understood, the Selected Remedy is an interim cleanup decision. Any changes to the cleanup decision, including additional actions to address MNR areas that do not achieve cleanup goals, will be made in the future in the final Record of Decision for OU1.

### 14.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and the NCP §300.430(f)(l)(ii)(B) require that remedial actions at CERCLA sites to at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA §121(d)(4). The selected remedy for the upland and intertidal areas will meet their respective ARARs from Federal and State laws. The selected remedy will meet substantive requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPS) relevant to particulate matter and air pollutants. The selected remedy will require transportation of contaminated environmental media to an offsite disposal facility and will be conducted pursuant to Federal and State transportation and disposal regulations. Facilities accepting these wastes will need to be certified to accept the wastes. Land disposal restrictions (LDRs) may (or may not) apply to offsite disposal of nonhazardous wastes; these restrictions will be determined once the waste is characterized during remedial design. The selected remedy will transport waste offsite for disposal, and therefore, will need to be compliant with applicable RCRA regulations (40 CFR 260-268). In addition to ARARs, worker safety provisions at 29 CFR 1910 will be observed.

**Commented [PHS(33]:** Ecology still wants to leave a room for the disposal at Subtitle D facility.

### 14.3 Cost-Effectiveness

The Selected Remedy is cost-effective because the remedy's costs are proportional to its overall effectiveness (see 40 CFR §300.430(f)(l)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all Federal and any more stringent State ARARs, or as

appropriate, waive ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness) collectively. The relationship of the overall effectiveness of the Selected Remedy was determined to be proportional to its costs and hence represents a reasonable value for the money to be spent.

The Selected Remedy for intertidal sediments excavates/dredges and disposes NAPL contaminated material in an offsite permitted landfill which will permanently reduce mobility. This remedy can be implemented in a short period of time, which is important because the beaches are the one area of the site where human exposure to contamination is not currently controlled through engineering controls.

14.4 Utilization of Permanent Solutions to the Maximum Extent Practicable

The Selected Remedy for intertidal sediments is a permanent solution because it removes and transports offsite NAPL contaminated sediment and emplaces a reactive barrier, overlain by clean material, to trap NAPL that could potentially upwell from lower depths.

14.5 Preference for Treatment as a Principal Element

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site whenever practicable (40 CFR 300.430[a] [1] [iii] [A]). As discussed in Section 11, EPA has determined that the contaminated intertidal sediments are not highly mobile or highly toxic. However, the Selected Remedy does include treatment through the use of sorptive materials in the cap, which will reduce mobility.

14.6 Five-Year Review Requirements

Section 121(c) of CERCLA and the NCP §300.430(f)(5)(iii)(C) provide the statutory and legal bases for conducting five-year reviews. Because this remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, statutory reviews will continue to be conducted every five years to ensure that the remedy is, or will continue to be, protective of human health and the environment.